LIFE IN SPACE AND HUMANITY ON THE EARTH

A Joint Review of Five Books

Shapley: The View From a Distant Star
Shapley: Of Stars and Men
Berrill: World Without End
Cameron: Interstellar Communication
Sullivan: We Are Not Alone

In the order in which the books are mentioned in the review.

by

Su-Shu Huang

I. The Astronomer's Contribution to Humanity

Buddha was enlightened by revelation under the Bohdi tree. He gained all the wisdom and truth about life through meditation in seven times seven days. The scientist's effort in trying to understand life has been by collecting facts. It is a tedious and painstaking process which may take millenniums. But in the end it appears that among their divergent ways of teaching and wisdom, the two cover some common ground and that is the virtue of humility.

When Charles Darwin proposed his theory of evolution that implied the humble origin of the human race, it was a severe blow to the human ego. Even after the lapse of a hundred years there are still many who find it difficult to accept. However, Darwin's theory and its consequent developments are not the topic under the present review as their impact and significance have been fully discussed. What I would like to call the attention to concerns another development in science which equally dampens the human ego. The topic is the problem of extra-terrestrial life.

The problem of extra-terrestrial life is closely related to how the man looks at his own position in the universe. Thus, before the heliocentric theory of Copernicus,

man regarded the earth as the center of the world and himself as the pinnacle of creation. This anthropocentric conception was prevalent in many philosophies and religions. Then Copernicus degraded the earth into a planet and implicitly raised the question of life in other planets. When it was further recognized that the sun is nothing more than just another star, the question was asked, as did the Dutch physicist Christian Huygens, "why may not every one of these stars or suns have as great a retinue as our sun, of planets, with their moons, to wait upon them?" It takes only a little more imagination to suggest that the planets "must have their plants and animals, nay and their rational creatures too, and those as great admirers, and as diligent observers of heavens as ourselves..." Huygens' view represented an early anticipation of the now accepted view but had to wait three hundred years before astronomers could support it with observations. In this respect, the situation is not unlike what has been encountered in the development of the theory of biological evolution. Long before Darwin, evolution had often been discussed but it took Darwin many years of field work in collecting facts before this concept was developed into a scientific theory.

How have the astronomers' observations contributed to the understanding of life in the universe? We may mention two aspects: First, he has put the problem in the perspective of the vast space and time. After Copernicus it was discovered that the sun with its planetary system is but only a tiny speck in the huge stellar system that is the Milky Way. Furthermore, the Milky Way system again is found to be only one of numerous galaxies that populate the universe. The successful entanglement by observations of the hierarchic structure of celestial systems is culminated in Hubble's expanding universe. In doing so the

[redacted]

astronomer puts the earth in an inconspicuous position. Or more generally, we may say that there is no priviledged position in space with respect to the distribution of matter in the universe.

The second part of his contribution has been to verify that physical laws that were discovered on the earth or in the solar system can be applied to the remote region of the universe. The first success in this direction was of course the application of Newton's law of gravitation to binary stars, making the law truely universal. But the most significant finding with respect to the problem of life elsewhere has been the discovery of uniformity of matter. Celestial bodies are found to be composed of the same kind of chemical elements as those present on the earth. The atoms and molecules in stars emit or absorb radiation in the same spectral lines and bands as we find them in the laboratory on the earth. In short the law of physics formulated from our experience on the earth does not depend upon the position in space. Or there is no priviledged position in space with respect to physical laws. Consequently, if life has appeared on the earth and moreover has developed a high intelligence, there is no reason why the similar phenomena cannot happen elsewhere. Under such a circumstance one can only conclude borrowing from Legge's translation [1] of Chuangtse: "when life comes, it is because it is time for it to do so. When life goes, this is the natural sequence of events." This concept of free but universal occurrence of life, I believe, is what the astronomer has truely contributed to the understanding of the meaning of life. Its socio-philosophical implication is evident since it teaches the basic principle that the nature is impartial and discriminates no one.

At this point I cannot help but point out a pure coincidence of the world affairs (on the earth) and scientific thinking. If we look back the history of the past twenty years and compare it with that before the war,

there is a definite improvement in the mutual understanding between men. We have not been enlightened overnight but we are going in this direction. Interestingly, this transition coincides roughly with the period when astronomers are abandoning the collision theory for the formation of the solar system and reviving the nebula theory which predicts the formation of the planetary system that is necessary for life emergence as a universal phenomenon.

H. Shapley, by observing the distribution of globular clusters, first discovered in 1918 that the solar system should be located near the rim, instead of at the center of the Milky Way system. This important discovery in astronomy, I believe, must have had a tremendous feed-back effect on his thinking because he has become a passionate crusader against the narrow "anthropocentric religions and philosophies." However, in his recent book, "The View from a Distant Star", he did not make a systematic exploration of this theme. Rather the book is a collection of his reminiscence and outlook about galaxies, stars, educational systems, international cooperation and other subjects that he has found an interest in. Indeed, many of the chapters in the book are based on lectures and on articles that the author has written from time to time. This explains the wealth of subjects that have been discussed in this relatively small volume. In each subject the author has some interesting points of view. He tells them with wit and originality of a style very much like a wise grandfather would to his grandchildren on long winter nights in order to instruct his youngsters as well as to delight them.

As an outstanding scientist with a keen interest in social and international problems he has much to say in many topics in as well as under the sky. In general, he emphasizes the overall similarity between physical phenomena

and human events. For example, in the chapter on "Stars Ethics and Co-existence" he first describes, literally, "the common breath of humanity." Since there are a great many molecules in one deep breath, these molecules will in the course of time spread by wind over the land and sea and enter the breath of every man, woman and child in the entire world. He then goes on to talk about physical events such as the propagation of waves that are necessarily international and finally leads to a discussion of co-existence between this country and USSR. His wisdom and his love for mankind can be seen every where in the book. It will certainly nourish the mind of young intellectuals to whom, I believe, the author has set himself to address and provide them food for thought.

The title of the book, "The View from a Distant Star" is a happy one because it is otherwise difficult to describe this all-inclusive and broad-scoped booklet that is a collection of reflections and wisdoms of an emminent scientist of this century. The subtitle, "Man's Future in the Universe", is however, slightly misleading as only a small part of the book deals with this problem.

Shapley's other book "Of Stars and Men" published first time in 1958 and revised in 1964 is a more systematic treatment of the author's stand than "The View from the Distant Star". It starts with a general introduction of cosmography — a term used by the author to describe "the field of study that has the same relation to the cosmos that geography has to the earth" which provides a good introduction for acquainting the reader with the universe we live in. It goes on to describe cosmic chemistry and the possibility that life may appear elsewhere because of the large number of stars that are present in the universe. Finally, the origin of life on the earth, the sense receptors in the animal world and the grim future hazards of the human race are discussed to conclude

the book. The central theme of the book concerns the position of mankind with respect to the nature.

The troubles we encounter in our world may have too many causes to be enumerated, but not the least is the human conceit and bias. Shapley's book is a good antidote for this human weakness. For this reason the book should be recommended to be on the list of required reading not only in science, but also in sociology courses in every high school in the world. To be on the record Shapley has not discussed sociological problems in this book. But any one who has read it will be taught a good lesson of open mindedness and an open mindedness in dealing with our follow men perhaps may ease many thorny problems that now face mankind.

From its attractive format the revised edition of this book may indeed be issued with the purpose for presenting it to the student readers. It is now beautifully illustrated and clearly printed on paper of good quality — a far cry from its unpretentious first edition. On the other hand, there are no major changes in the text from the first edition apart from an addition of a short index and a splitting of one chapter into two.

II. Emergence of Intelligence - A Biological Problem

If we take a look at living beings around us, we must be impressed by their great varieties. Actually, they represent only a fraction of what has existed on the earth. If we further remember that all the living things that have ever appeared on the surface of the earth might have descended from the same unicellular organism that emerged by chance in the early phase of the earth's existence, we cannot avoid the conclusion that even if the basic chemistry of life elsewhere is due to the same carbon reactivity that is well known to us, the actual forms of

life in other worlds and their evolutionary sequences must have an extremely wide range of possibilities. Thus, the appearance and evolution of living organisms should behave like the chess game or more properly the Chinese game of "GO" [2] (Wei-ch'i in Chinese) which is now more popular in Japan than in China.

In this game of GO, two players start with an empty board on which there are 19 x 19 = 361 vacant spots at the intersections of two sets of mutually perpendicular lines and take turns in placing their stones, one at a time in any of the vacant spots on the board. From time to time one or more stones can be captured by the opponent and removed from the board. The spots where stones have been removed become once again vacant and ready for further placement by both sides. Hence, without understanding the rule of the game, one can immediately realize that the chance of playing two games in an identical way is vanishingly small.

The living organisms of course, face more varieties of choices in each step in their evolutionary sequence than the GO players do. Perhaps it is due to this reasoning that Shapley is not an enthusiast for interstellar communication in spite of his keen interest in the general problem of life in the universe. He said in The View from a Distant Star "Perhaps we should first attempt reciprocated communication with non-human organisms here on the earth — say with a vegetable or a scarab bettle, or a termite queen-mother who represents the highest natural societal organization known on this planet. Foolish suggestions, yes, but they suggest the difficulty and probable impossibility of interplanetary communication."

Shapley's idea is shared by others like G. G. Simpson (Paleontologist) and H. F. Blum (Biologist). They argue that the chance of taking the direction towards intelligence in biological evolution is small and question the wisdom

of their fellow scientists for talking about interstellar communication or even exobiology.

On the other hand, we may also argue that although there are a large number of ways that biological evolution may actually proceed, a large fraction of them may tend upward with high intelligence. For after all the evolution is not a blind process; it must be guided by natural selection. Just like the game of GO, the better player always ends up by winning the game, so is the game of biological evolution natural. Living organisms that can adopt to/its natural environment always have a high chance of emergence and survival.

In a recent article in this journal, R. Bieri [3] a biologist, gives a convincing argument in favor of the inevitable emergence of intelligence in the course of biological evolution. He concluded "Given the ninety-two known, naturally occurring elements, the forms of energy available, and limited time, the number of alternative solutions to the major steps leading to a conceptual organism are strictly limited. The phenomenon of convergent evolution is so widespread in both the plant and animal kingdoms that it needs no special elucidation here. Suffice it so say that the evidence shows that, again and again, animals and plants have independently evolved not only similar structures but also similar biochemical systems and similar behavioral patterns as solutions to the same fundamental problems".

In presenting these two opposing views, I do not pretend to know which one has a stronger argument than the other. But it clearly shows that the basic uncertainty concerning life in the other worlds lies in the domain of biological sicnece. For this reason, I had a great expectation for the book, "Worlds Without End" subtitled "A Reflection on Planets, Life and Time" by N. J. Berrill because the author is a zoologist. However, after I have

read through the book, I find myself in a most disappointed mood. Actually one does not have to go very far in the book before he realizes that the author not only has nothing new to say on this subject but also is ill prepared for what are already known. In the first two chapters of 31 pages, the author quoted long passages of science fictions in 5 places with a total length of 8 pages and mentions Jules Verne four times. It gives the impression that only writers of science fictions know anything about Venus and the Moon for these are two subjects discussed in the first two chapters. Not a single name among many modern astronomers who actually observe Venus and the Moon is mentioned, let alone quoted. The trend of quoting science fictions at length of course is not limited to the first two chapters but is a conspicuous feature of the entire book.

Although the book covers astronomical problems in about two-thirds of the volume, it is reasonable to suspect that the author has received little formal training in astronomy. This suspicion may be seen from the dubious and ambiguous statements the author made in the book. For example, we find on p. 70, "According to Kepler's rule of location of planets, a planet should exist between Mars and Jupiter,..." Again on p. 182, "After all, Kepler found the rule for spacing and left room for the undiscovered asteroids in an empty orbit between Jupiter and Mars." It is evident that the author is confused between Kepler's law of motion of planets and Bode's law of planet spacings-an obvious mistake that no one who has ever taken a course on elementary astronomy would easily make.

III. Interstellar Communication

The debate on the emergence of intelligence from the biological point of view has been overshadowed by the more existing and fascinating discussions of interstellar

communication and even of interstellar travel from the technological point of view. "Interstellar Communication" edited by A.G.W. Cameron and "We Are Not Alone" written by W. Sullivan are two representatives of this tendency. They describe the outlook of life in other worlds and the consequent possibilities as seen, mainly, by physical scientists and engineers. The fact that both books treat the problem in this way is not because the books are intentionally biased in favor of the technological point of view but because little has been written from the biological point of view. From what we have already said in the previous section, the relative reluctance of biological scientists in dealing the problem at hand is understandable. However, this leaves the discussion of this important problem incomplete. The situation may best be illustrated by the construction of a building. Astronomers, by their finding of the universality of matter and physical laws in the universe, have built the foundation which made a scientific discussion of life in the universe possible. Now physical scientists in other fields have found means for interstellar communication. In our example, it means that a magnificent roof of the building has been built. But between the foundation and the roof little has been constructed, leaving the roof somewhat dangling in the air without support. To fill up the gap, discussions by biologists, such as one by Bieri [3] quoted before, are urgently needed.

Sullivan, science editor for the New York Times keeps the tradition of this newspaper by reporting every idea and every speculation advanced in the past several years that he has either found in the literature or heard in meetings or interviews. In many cases he traces the history of the topic to the very beginning and provides the reader with a necessary background in every instance whether in astronomy, in biology, or in whatever field he is dealing

It is apparent that before he wrote this book he had done a thorough research himself. Indeed his thoroughness in reporting the life problem outside the earth can be attested to by the fact that for the last several pages of the book he has summarized some discussions, by both clergy and laity, on the spiritual significance of life in outer space.

The book is easy to read, and both scientists and laymen will find it interesting. If any one has a desire to learn something about the present state of our knowledge about extra-terrestrial life, this is the book to begin with. If he becomes fascinated with any particular problem, the author provides at the end an extensive biography for his further study.

What I myself find most interesting is the chapter on "Wax and Wigglers" which treats the question of whether the carbonaceous materials of some kind of meteorites (Orgueil) have their origin in extra-terrestrial life. Sullivan describes vividly the arguments -- scientific as well as emotional -- used by both sides in this great debate and finally concludes by observing "The Orgueil debate as a classic example of a scientific discussion becomes personal, emotional and enmeshed with professional pride. The talents and ingenuity of participants have been directed toward proving their case, rather than seeking out the truth. They have thus demonstrated that they are human, but the wonderful self-disipline and objectivity that we call pure science has suffered." Actually, in the entire book this may perhaps be the only place that the author injects his personal opinion. Elsewhere he has kept his function purely as an objective reporter -- a not surprising fact if we remember his background as science editor with the New York Times.

"Interstellar Communication" is a scientific anthology that includes 22 reprints of papers published originally in the period 1959-1962 and 10 articles written specially for this book. Some of the latter are written by the editor himself and provide a general astronomical background of the subject. This collection reflects the state of mind of some scientists (mostly physical scientists) as regards the emergence of life in the universe and its technological implications, such as interstellar communication and travel, at the dawn of the space age. Therefore, the collection serves three purposes, for popular reading, for inspiring further studies and as a record of the time. The value of popularization of this collection is somewhat reduced, a little more than one year after its publication, by the appearance of Sullivan's book mentioned previously because the latter discusses, among other things, the essential points contained in nearly all articles in Cameron's collection. Of course, papers in Cameron's collection are most original and go into more technical details than can be obtained from the book by Sullivan whose purpose is solely for popular information. Hence, for references of scientists themselves and a record of their prophets in the early stage of a new branch of science, Cameron's collection cannot be surpassed.

Ours is the age of technology. No one can deny its powerfulness and influence if he just takes a look at the progress it has made in the past generation. The atoms have been tamed so that they can be split or fused according to our wish. The gravity of the earth has been overcome so that we are now ready to go to the moon and eventually to other planets. Now we begin to see even the means for communicating with technological societies in the other parts of this vast galaxy. Ironically, however, we have not yet discovered a sure way to communicate each other with understanding between beings on this little earth.

IV. Supercivilization and the Problem of Man's Future

A discussion of interstellar communication necessarily leads to the problem of "other" civilizations or civilizations we can communicate with. Since we are only on the threshold of such a venture, it immediately follows that a civilization that can be contacted must be more advanced than ours. Consequently, a great deal has been [illegible] "supercivilization". Three scientists boldly and drastically have suggested three possibilities that beings in these supercivilized societies might do with their super-technology.

In 1960, F. J. Dysen (theoretical physicist) of the Institute for Advanced Study argued in the words of Sullivan that "the population growth in such worlds would have continued to press the limits of available sustenance, as set forth in the theory of Thomas Robert Malthus at the end of the eighteenth century. The limiting factors in such a situation would be the available material and the available energy. Both of these shortages could be met by dismembering one or more planets of that solar system and using the material to build a shell completely enclosing the parent star. The entire energy radiated by the star would then become available---40,000 billion times that which falls on the earth."

R. N. Bracewell (radio astronomer) of Stanford University has another idea for what supercivilizations would do. He argued that instead of scanning the candidate stars with the radio telescope for the telltale voice of other communities in the galaxy, a supercivilization would send antomated messengers to orbit each candidate star in order to find out whether a technological civilization has reached maturity there. According to him such a messenger would be powered by light from the candidate star and therefore resemble some of our own space probes except in different scales in time and space. He further points out that such a messenger "may be here now, in our solar system, trying to make its presence known to us"

and mentions the strange radio echoes which he thinks as never satisfactorily explained.

Finally, C. Sagan (astrophysicist) of Harvard University has even a more ambitious scheme for super-civilizations. He saw travels in interstellar space as a real possibility perhaps even a necessity. For he said "It reopens the arena of action for civilizations where local exploration has been completed; it provides access beyond the planetary frontiers, where the opportunities are limitless." Consequently "a central galactic information repository" may be established in order to assemble the knowledge of galactic communities.

I cite these three examples all of which are included in Sullivan's book (two of the original papers are included in Cameron's anthology, while Sagan's work came out after its publication) not only because they are extra-ordinary but also because they induce me to ask the question: will our own technological civilization reach this super state?

The three scientists just mentioned did not touch on these questions. However, by assuming the appearance of supercivilizations in the galaxy, they tacitly imply a great future for the technological civilizations of our own. Such an inferrence, however, is at variance with the conclusion derived some years ago by two other scientists. Each of them wrote a book that discusses the future of man and his civilization. I refer to "The Next Million Years" by Charles G. Darwin [4], grandson of the author of the "Origin of Species" and a well known physicist himself, and "The Challenge of Man's Future" by H. Brown (geophysicist) of California Institute of Technology [5]. These two authors give us a bleak prediction for our future.

Darwin argues that any nature faces a dilemma in adopting a policy for its own population. In the first place if one nation limits its population, it faces the danger of being crowded out by other nations that do not follow such a policy. He cites also the other damaging consequences of such a policy. On the other hand, without suitable restraint on the population in the world, the future of man can only be involved in a bitter struggle for food and survival. Therefore, Darwin concludes that the civilization of man on the earth is at its peak now and we can look for nothing in the future but its decline.

While Darwin discusses in his book the long range future of man from certain general principles that he assumes, Brown's book which Einstein called an objective book of high value concerns our immediate future by presenting first the statistical data about the world population, resources, and the rate of consumption of these resources. From these data and the present world situations with respect both to the population, resource and industrialization, Brown sees three possible patterns of life "The first and by far the most likely pattern is a reversion to agrarian existence... as the second likely possibility, (it is) the completely controlled, collectivized industrial society. The third possibility confronting mankind is that of the world-wide free industrial society in which human beings can live in reasonable harmony with their environment." Brown does not think the third possibility can ever exist for long but still gives a high hope that it will if we prepare ourselves in time. In any case, both Darwin and Brown do not have such high expectations for the advanced technology that are implicitly contained in suggestions by Bracewell, Dyson and Sagan.

If we now examine the background of these five scientists, we find that they are all outstanding in their respective fields of physical science. But the future of the technological civilizations they foresaw are completely different. Such diagonally different expectations of our future reflect the difficulties and uncertainties that are involved in the human relationship that defies a rigorous analysis that we find in physical science.

My point of presenting this case is not to express my own view on this problem. Honestly, I am greatly impressed by the arguments of Brown and Darwin on the one hand and still maintain a great expectation for our own technological civilization as envisaged by Bracewell, et al., on the other. The point I want to make is more earthly and of a much shorter time scale than they discuss. It concerns the state of mind of the man, in a time scale in terms of a generation instead of a millennium.

Physical scientists and the great majority of the general public alike are now elated by their past successes and become exceedingly confident in their ability for molding a glorious future for mankind. The progress appears to them to be without limit and the great expectations reflect this high mood of euphoria. This mood bears some resemblance to the way a child entertains himself in the evening before he is taken to a carnival that he has never attended before. For this reason we may take these great expectations of technological possibilities as romantic lyrics that pay homage to the mighty of technology as well as express the joy of us scientists in this generation that follows the opening of the space age. Since it is this state of mind that actually helps us make progress, as recently amplified by Schwarzschild [6] in his statement before the Committee on Aeronautical and Space Sciences of the United States Senate, we should cherish it.

REFERENCES

1. J. Legge, in "Sacred Books of the East" 39, 243 Clarendon Press, Oxford, 1891, I used the phrase "borrowing from..." in order to show that the meaning implied here is not exactly what Chuangtse originally meant.
2. L. B. Tobolsky, Am. Scientist, 52, 358 (1964).
3. R. Bieri, Am. Scientist 52, 476 (1964).
4. C. G. Darwin, "The Next Million Years", Doubleday and Co., Garden City, New York (1952).
5. H. Brown, "The Challenge of Man's Future", Viking Press, New York (1954).
6. M. Schwarzschild, Pub. Astr. Soc. Pacific 75, 527, (1963).